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(54) **WINCH HAVING INTERNAL CLUTCH MECHANISM**

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(52) **U.S. Cl.** **254/344**; 254/349; 254/350
(58) **Field of Search** .... 254/344, 349, 254/350, 361, 367, 379; 474/269, 146, 116; 192/85 AA, 20

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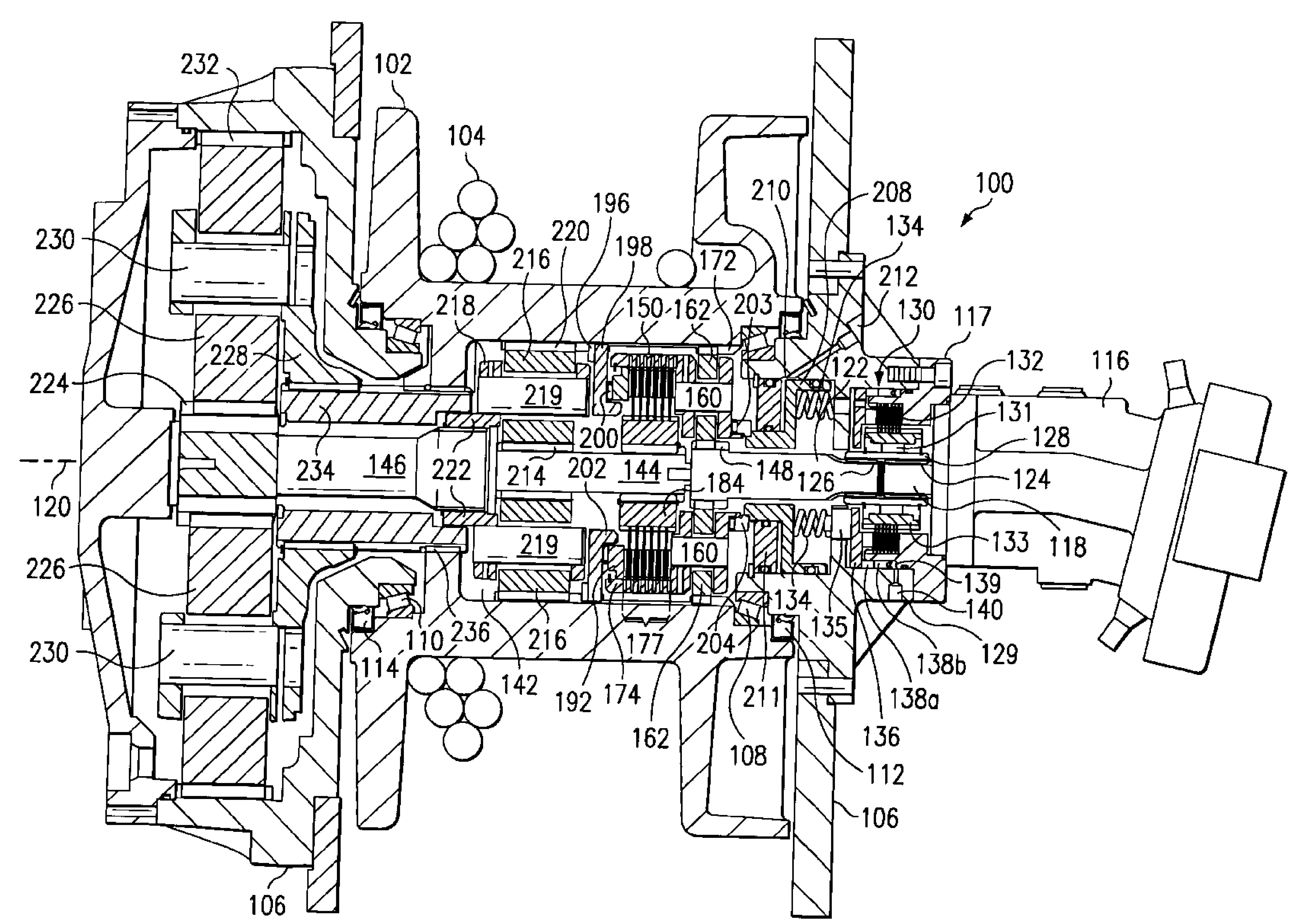
(57) **ABSTRACT**

A winch comprises a drum rotatably mounted on a housing for winding a cable thereupon. A motor is attached to the housing, the motor supplying torque through a motor shaft. A special stage of planetary gears is mounted to the housing for transmitting torque between the motor shaft and the drum. The special stage of planetary gears includes a sun gear for receiving torque, a carrier/clutch unit and an annular ring gear encircling the carrier/clutch unit. The carrier/clutch unit includes a frame rotatably mounted to the housing and having walls defining a cavity therein, at least one circumferentially-spaced planet gear rotatably mounted on the frame for simultaneously engaging the sun gear and the ring gear, a selectively engagable clutch mounted within the cavity of the frame, and an output member which, when the clutch is engaged, can receive useful torque from the frame and, when the clutch is disengaged, cannot receive useful torque from the frame.

21 Claims, 4 Drawing Sheets



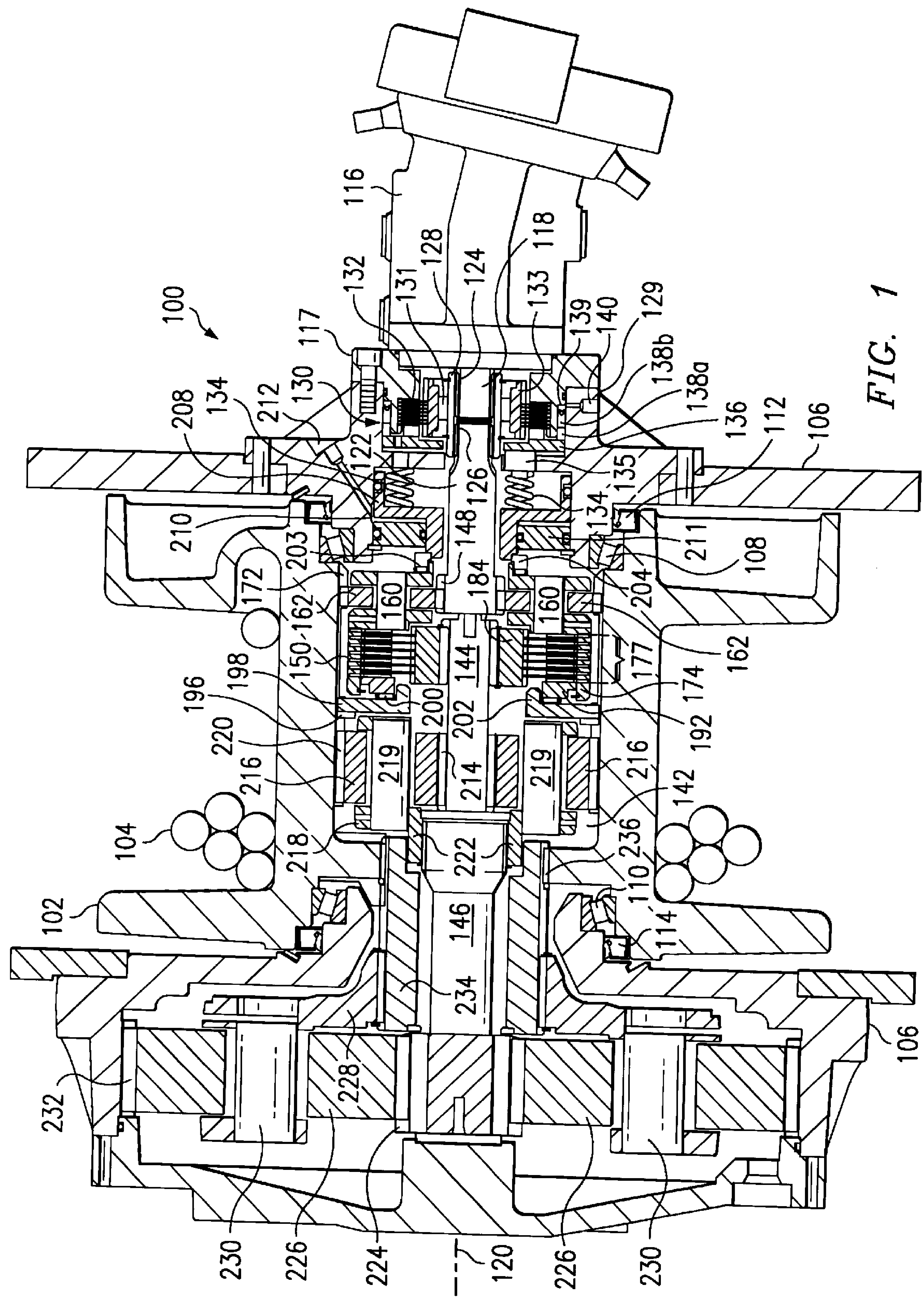

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FIG. 1

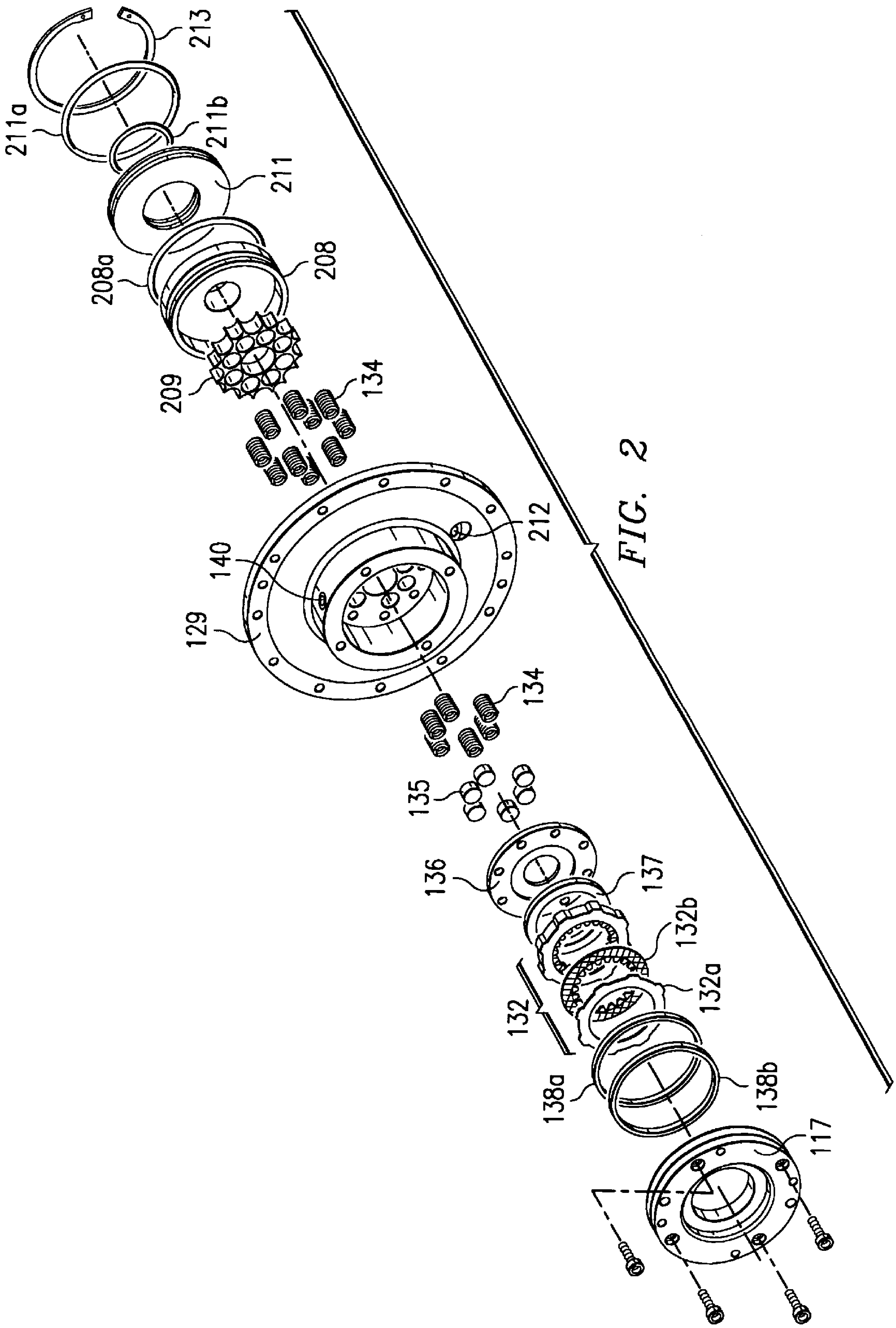
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FIG. 2

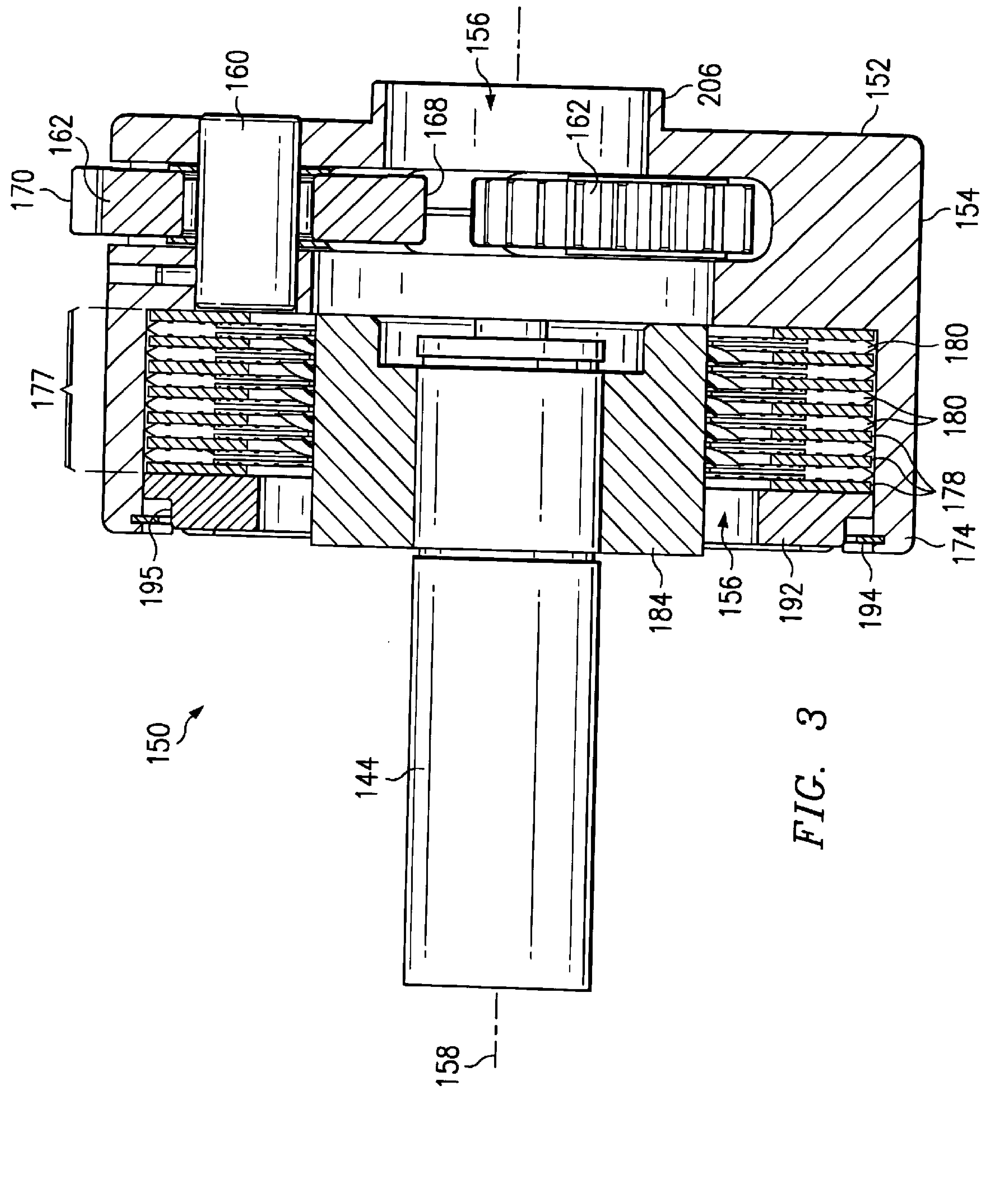
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FIG. 3

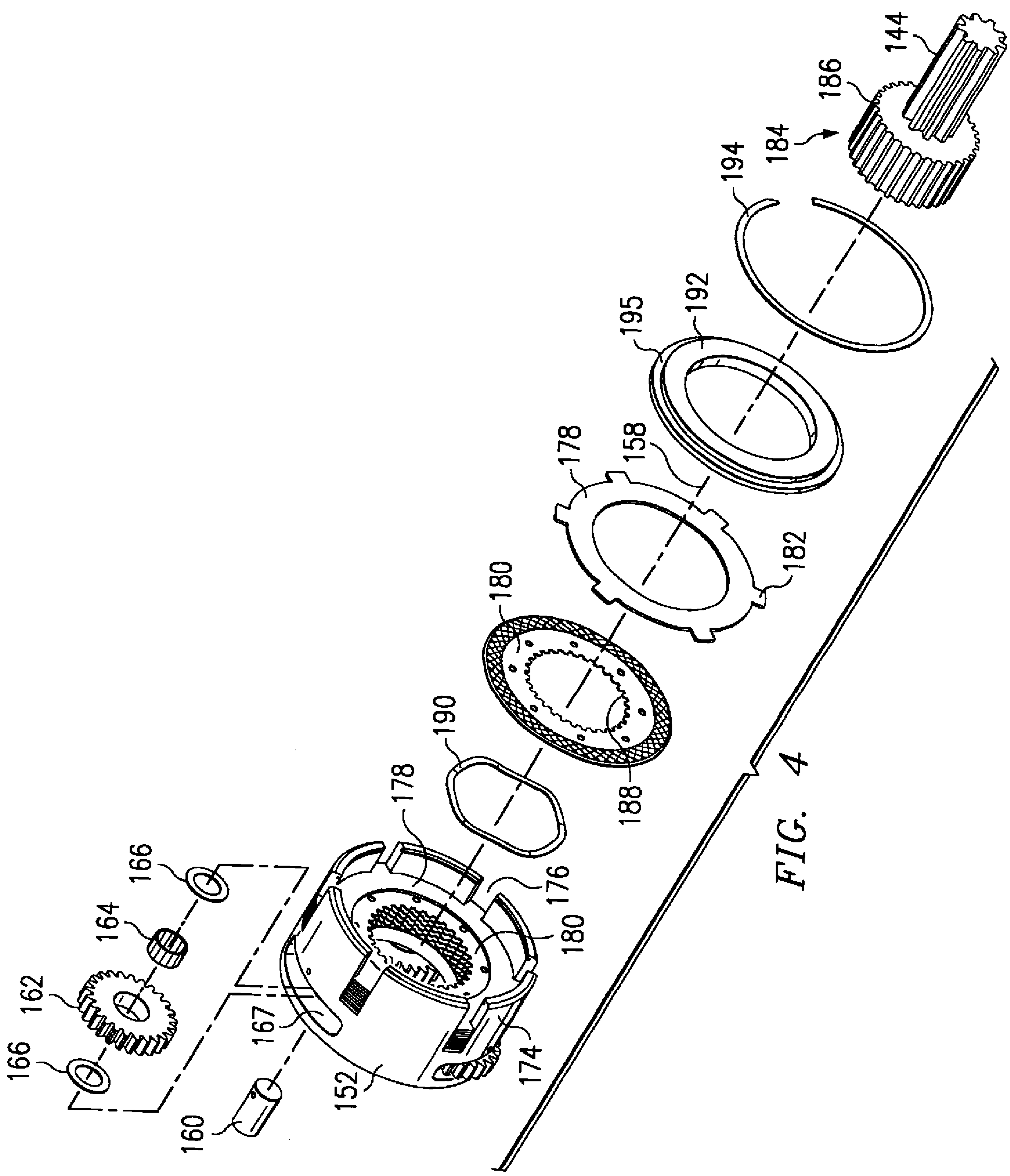
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FIG. 4

WINCH HAVING INTERNAL CLUTCH MECHANISM

TECHNICAL FIELD OF THE INVENTION

The present invention relates generally to power driven winches of the type having internal planetary gears for driving the cable drum. In one embodiment, the invention relates to a winch having an internal friction clutch mechanism for selectively connecting and disconnecting the cable drum to the power input.

BACKGROUND OF THE INVENTION

Winches using one or more sets of planetary gears to transfer torque from a power input (e.g., winch motor) to the cable drum are well known. Further, it is known to provide an internal clutch mechanism in such winches for selectively connecting and disconnecting the cable drum to the winch motor whereby, for example, the clutch can first be disengaged to allow cable to be unreeled from the drum without operating the motor, and then the clutch can be engaged to allow the motor to power the drum for reeling in the cable against the load. Where it is desirable for the drum clutch mechanism be gradually engaged and disengaged while under load, the clutch mechanism must be of the type known as a friction clutch.

Heretofore the use of internal drum friction clutch mechanisms, especially those used in high-capacity winches, for example winches used on earth-moving machines, construction equipment or heavy trucks, has presented certain disadvantages. The reduction gear train of such winches includes multiple stages of planetary gears which take up a considerable amount of space. Typically, the drum friction clutch mechanism is located at a gear stage close to the cable drum where the torque it must transmit is relatively high, and as a result, the clutch mechanism must be physically large (e.g., large diameter) to handle the high torque requirements without failing or wearing prematurely. A first disadvantage of previous designs is that the size of such high-torque friction clutches is sometimes so large that it increases the overall size of the winch, either requiring the diameter of the winch housing to be increased, or requiring the clutch to be located to one side of the cable drum, thereby increasing the overall width of the winch. Obviously, this increased size can make it much more difficult to mount a high capacity winch on existing equipment. A second disadvantage of previous designs is that the large size and/or complexity of the high-torque friction clutches results in higher cost for their components and manufacture, consequently raising the cost of the associated winch. This of course, puts the manufacturer at a competitive disadvantage.

A need therefore exists, for a winch having a design which minimizes the size of the internal drum friction clutch to reduce the overall size of the winch. A need further exists, for a high-capacity winch with internal drum friction clutch having a simplified design which reduces the costs of manufacturing the winch.

SUMMARY OF THE INVENTION

The present invention disclosed and claimed herein comprises, in one aspect thereof, a winch including a drum rotatably mounted on a housing for winding a cable thereupon. A motor is attached to the housing, the motor supplying torque through a motor shaft. A special stage of planetary gears is mounted to the housing for transmitting torque between the motor shaft and the drum. The special stage of planetary gears includes a sun gear for receiving torque, a carrier/clutch unit and an annular ring gear encircling the carrier/clutch unit. The carrier/clutch unit includes a frame rotatably mounted to the housing and having walls defining a cavity therein, at least one circumferentially-spaced planet gear rotatably mounted on the frame for simultaneously engaging the sun gear and the ring gear, a selectively engagable clutch mounted within the cavity of the frame, and an output member which, when the clutch is engaged, can receive useful torque from the frame and, when the clutch is disengaged, cannot receive useful torque from the frame.

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the present invention and the advantages thereof, reference is now made to the following description taken in conjunction with the accompanying drawings in which:

FIG. **1** illustrates a longitudinal cross sectional view through a winch in accordance with one embodiment of the current invention;

FIG. **2** illustrates an exploded perspective view of the static brake assembly and the drum friction clutch activation mechanism;

FIG. **3** illustrates an enlarged longitudinal cross sectional view through the carrier/clutch assembly of the winch; and

FIG. **4** illustrates an exploded perspective view of the carrier/clutch assembly.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to FIG. **1**, there is illustrated a hydraulic winch in accordance with one embodiment of the current invention. The winch **100** includes a cylindrical drum **102** around which a cable **104** is wound in a conventional manner. The drum **102** is rotatably supported on a housing **106** by bearing assemblies **108** and **110** located at each end. Seal assemblies **112** and **114** are provided between the housing **106** and the drum **102** to prevent dirt, water or other foreign materials from entering the internal mechanism.

Power for the winch **100** is provided by a hydraulic motor **116** mounted to a motor support **117** forming one end of the housing **106**. A motor shaft **118** projects into the housing **106** along a longitudinal axis **120** providing torque to the reduction gear mechanism of the winch. As will be explained in further detail below, the reduction gear mechanism receives torque from the motor shaft **118**, multiplies the torque though gear sets, and delivers the torque to the drum **102** to allow the cable **104** to be reeled onto the drum against a load.

In the embodiment shown, the reduction gear mechanism receives torque from the motor shaft **118** at a primary sun gear **122**. The primary sun gear **122** has a longitudinally extending portion that extends along the axis **120** and abuts, but does not directly engage, the end of the motor shaft **118**. External splines **124** on the motor shaft **118** and external splines **126** on the adjoining portion of the primary sun gear **122** are received into opposite ends of an internally splined connecting collar **128**. The connecting collar **128** allows torque to be transmitted between the motor shaft **118** and the primary sun gear **122**, and further connects the reduction gear mechanism to a static brake assembly **130**.

The static brake assembly **130** is a safety and control feature of the winch **100** that holds the load when no power is applied to the winch and also remains applied during reel-in of the cable onto the winch drum **102**. The static brake assembly **130** includes an over-running (i.e., one-way) clutch **131** disposed in the annular space between the connecting collar **128** and an encircling multi-disc brake **132**. The over-running clutch **131** is preferably a sprag-type clutch, however, other types of one-way clutches may be used. The multi-disc brake **132** may be of conventional design, and it selectively connects the outer portion **133** of the over-running clutch **131** to the stationary motor support **117**. When the static brake assembly **130** is applied (i.e., by engaging the brake **132**) the over-running clutch **131** allows the connecting collar **128**, and hence the motor shaft **118** and primary sun gear **122**, to rotate freely in the reel-in direction, but it immediately locks-up (i.e., immobilizes) the collar **128**, motor shaft **118** and primary sun gear **122** if they try to turn in the reel-out direction. When the static brake assembly **130** is released (i.e., by disengaging the brake **132**), the connecting collar **128**, motor shaft **118** and primary sun gear **122** can rotate in either direction. In use, the static brake assembly **130** typically remains applied during reel-in operation of the winch. The over-riding clutch **131** will rotate freely to haul-in a load and lock up immediately to hold the load, with no "fall back," when the winching operation is stopped. Similarly, there is no momentary "fall back" as the operator begins to haul-in as the static brake assembly **130** is not released. The static brake assembly **130** is typically released only if it necessary to rotate the motor shaft **118** and primary sun gear **122** in the reel-out direction.

Referring now also to FIG. **2**, there are illustrated additional details of a static brake assembly **130** in accordance with this embodiment. The static brake assembly **130** is spring applied and hydraulically released, and in this case is disposed within a cavity formed by attaching the motor support **117** to a brake housing **129** (both parts **117** and **129** being portions of the winch housing **106**). A plurality of springs **134** extend through holes in the end wall of the brake housing **129** and push via spring pucks **135** against a movable pressure plate **136**. The pressure plate **136** pushes via a spacer **137** against one side of the multi-disc brake (denoted collectively **132**), compressing it against the end wall of the motor support **117**. As best seen in FIG. **2**, the multi-disc brake **132** comprises a plurality of externally keyed discs **132*a***, which engage the inner surface of the side wall of the motor support **117**, interleaved with a plurality of internally toothed discs **132*b***, which engage the outer portion **133** (see FIG. **1**) of the over-riding clutch **131**. A back-up ring **138*a*** and a seal ring **138*b*** are disposed within an annular cavity formed between the outer surface of the side wall of the motor support **117** and the concentric inner surface of the side wall of the brake housing **129**. The parts **138*a***, **138*b*** and **138*c*** form a piston which bears against the outer rim of the pressure plate **136** on the same side as the spacer **137**.

The static brake assembly **130** of this embodiment is "applied" when the discs **132*a*** and **132*b*** are compressed together between the spring-biased spacer **137** and the end wall of the motor support **117**, thus frictionally locking the outer member **133** of the over-riding clutch **131** to the stationary motor support **117** and preventing its rotation. The static brake assembly **130** is "released" by introducing hydraulic fluid into a cavity **139** (see FIG. **1**) through a port **140** in the brake housing **129**. The hydraulic fluid forces the piston made by O-ring **138*c***, seal **138*b*** and back-up ring **138*a*** against the pressure plate **136**, overcoming the bias of the springs **134** and moving the pressure plate **136** and spacer **137** away from the brake discs **132** until their friction no longer provides substantial resistance to rotation of the outer member **133** with respect to the stationary motor support **117**. It will be appreciated that, as its name implies, the static brake assembly **130** is applied and released only when the winch mechanism is stationary. Further, it functions only to prevent rotation of the winch mechanism in the reel-out direction. The static brake assembly **130** does not, and cannot, function as a drum clutch (i.e., allowing the drum **102** to move independently of the motor shaft **118**) because the motor shaft **118** and the primary sun gear **122** are constantly meshed by the brake's connecting coupling **128**.

As previously indicated, in this embodiment the primary sun gear **122** represents the beginning of the winch reduction gear mechanism. Multiple stages of planetary gears are then used to multiply and transmit the torque received from the motor shaft **118** to the winch drum **102**. In the embodiment shown, the first two reduction gear stages are positioned inside the cylindrical cavity **142** defined by the winch drum **102**. This arrangement makes maximum use of the space inside the winch housing **106** and thus helps to minimize the overall size of the winch. The sun gears for the three reduction stages, namely the primary sun gear **122**, the secondary sun gear **144** and the final sun gear **146**, are all located coaxially along the longitudinal axis **120**. While not required, this coaxial arrangement is often preferred because of the resulting low-profile design.

The axially elongated primary sun gear **122** has external teeth **148** formed on its inner end. In a conventional planetary gear arrangement as used in prior art winches, the external teeth **148** of the primary sun gear **122** engage a plurality of circumferentially spaced planet gears mounted on a conventional carrier by means of stub shafts. These planet gears simultaneously engage an encircling ring gear in the known manner. The conventional carrier typically has internal splines or teeth in fixed constant mesh with corresponding splines or teeth on the sun gear of the next reduction stage. In this manner, torque is constantly transmitted between the first and second reduction stages in a conventional winch. In the current invention, however, a special stage of planetary gears is used which does not include a conventional planet carrier. Instead, the special stage includes a carrier/clutch unit **150** which, as further explained herein, serves as both a planetary gear carrier and as a compact friction clutch for engaging and disengaging the winch drum **102** from the motor shaft **118** to allow relative motion therebetween.

Referring now also to FIGS. **3** and **4**, there is illustrated in further detail the carrier/clutch unit **150** of this embodiment. The carrier/clutch unit **150** includes a cylindrical frame **152** defining an outer periphery **154**, an inner cavity **156** and a longitudinal axis **158**. In the embodiment shown, the longitudinal axis **158** of the carrier/clutch unit **150** is coincident with the longitudinal axis **120** of the winch **100**. The carrier/clutch frame **152** is adapted to receive a plurality of planet gear shafts **160** that are disposed circumferentially around, and oriented parallel to, the longitudinal axis **158**. A planet gear **162** is rotatably mounted on each planet gear shaft **160** by means of a bearing assembly **164** and thrust washers **166** (FIG. **4**). In the embodiment shown, circumferential slots **167** are formed in the frame **152** to accommodate the planet gears **162**. Each planet gear **162** is sized to extend radially outward past the outer periphery **154** of the frame **152** and radially inward into the central cavity **156** of the housing after installation. As with a conventional planetary gear carrier, the carrier/clutch unit **150** serves as part of a planetary gear stage by simultaneously engaging the planet gears **162** between the primary sun gear **122** on their radially inward sides (denoted by reference numeral **168**) and an encircling ring gear on their radially outward sides (denoted by reference numeral **170**). In the embodiment illustrated, the encircling ring gear is provided by internal teeth **172** integrally formed on the inside surface of the winch drum **102** (see FIG. **1**). Accordingly, when the primary sun gear **122** is rotated, the frame **152** of the carrier/clutch unit **150** rotates in the same direction at a predetermined ratio.

Unlike conventional planetary gear carriers, the frame **152** of the carrier/clutch unit **150** has a longitudinally extending wall **174** in which are formed a plurality of longitudinal slots **176**. A clutch (denoted generally by reference numeral **177**) including a plurality of annular separators **178** interleaved with a plurality of annular friction discs **180** is disposed inside the longitudinal wall **174** within the inner cavity **156**. The separators **178** have a plurality of tabs **182** disposed along their outer periphery which engage the longitudinal slots **176** of the carrier/clutch frame **152**, whereby the separators are rotationally locked to the housing but can move longitudinally. It will be appreciated that while the current embodiment prevents rotation of the separator discs **178** relative to the frame **152** by mating separator tabs **182** into frame slots **176**, other known locking configurations may be employed in alternative embodiments, for example, splines, gear teeth, keys and key-ways, scalloped edges, and the like. An adaptor **184** having a plurality of external splines **186** engages a plurality of teeth **188** formed on the inner annulus of each friction disc **180**, whereby the friction discs are rotationally locked to the adapter, but can move longitudinally. The elongated shaft **144** of the secondary sun gear engages the adaptor **184** by means of internal splines or teeth such that the shaft and adaptor are rotationally locked together and can transmit torque therebetween. Alternatively, the secondary sun gear and the adaptor may be formed as a single integral part. A plurality of annular wave springs **190** (best seen in FIG. **4**) dimensioned to fit within the annulus of the separators **178** may be interleaved between the friction discs **180** to urge the friction discs longitudinally away from one another during disengagement of the clutch **177**. The wave springs **190** are preferred, but are not required. An annular pressure plate **192** is fitted into the open end of the carrier/clutch frame **152** and secured with a snap ring **194** to retain the friction discs **180** and separators **178**. The pressure plate **192** is provided with an inset lip **195** which allows limited axial movement of the plate with respect to the snap ring for purposes of engaging and disengaging the clutch **177**.

The clutch **177** of the carrier/clutch unit **150** is engaged by applying longitudinal force (i.e., a force directed parallel to the longitudinal axis **120** of the winch) inward against the frame **152** and the pressure plate **192**, thereby urging the friction discs **180** and separators **178** to move longitudinally into increasing frictional contact with one another until the friction is sufficient to allow the desired amount of torque to be transmitted therebetween (and hence between the respectively connected carrier/clutch frame **152** and adaptor **184**). The clutch **177** is disengaged by reducing the inward longitudinal force on the housing and pressure plate, whereby the frictional contact between the friction discs **180** and separators **178** is reduced to the point that useful torque cannot be transmitted therebetween. Put another way, when the clutch **177** of the carrier/clutch unit **150** is engaged, the carrier/clutch frame **152** and the adaptor **184** (with the secondary sun gear shaft **144**) rotate together. When the clutch is disengaged, the frame **152** and the adaptor **184** (with the secondary sun gear shaft **144**) are uncoupled and thus may rotate with respect to one another.

Since the carrier/clutch unit **150** is disposed within the central cavity **142** of the cable drum **102**, it is necessary to provide means for applying and releasing longitudinal force to the unit (needed to activate the clutch **177**) while still allowing the unit to rotate freely. In the embodiment illustrated in FIG. **1**, a snap ring **196** is fitted into a groove formed approximately midway along the interior wall of the drum **102**. The snap ring **196** provides longitudinal support for an abutting thrust ring **198**. The thrust ring **198**, in turn, provides longitudinal support for the carrier/clutch unit **150** by pressing laterally against the pressure plate **192** via a bearing assembly **200**. The thrust ring **198** also provides radial support for the bearing assembly **200** with its annular lip **202**. To ensure that the thrust ring **198** does not rotate under the influence of the bearing assembly **200**, the periphery of the thrust ring is preferably provided with external teeth which engage the internal teeth **172** of the drum **102**. Alternately, a key or other known securing mechanism may be provided to prevent rotation of the thrust ring. The opposite end of the carrier/clutch unit **150** is supported by a bearing assembly **203** and a race **204** that bears longitudinally against the frame **152** and surrounds the housing lip **206** (see FIG. **3**) to position the unit radially. The opposite side of the race **204**, in turn, is supported by a moveable stepped piston **208** that is slidingly disposed within a cylindrical portion of the brake housing **129**.

Longitudinal compressive force on the carrier/clutch frame **152** (i.e., for engaging the clutch **177**) is provided by springs **134** via the piston **208**, race **204** and bearing assembly **203**. It will be appreciated that some of the springs **134** acting on the drum clutch **177** extend through holes in the brake housing **129** and also act upon the multi-disk brake **132** as previously described, while others of the springs **134** are compressed against the end wall of the brake housing and act only upon the drum clutch. This dual-use design eliminates the need for separate springs just to activate the brake **132**, and may also reduce the overall width of the winch. A spacer **209** may be provided to position the springs **134** within the cavity formed behind the stepped piston **208**. The force from springs **134** urges the carrier/clutch frame **152** to move longitudinally toward the stationary thrust ring **198**, thereby compressing the friction discs **180** and separators **178** together in frictional engagement such that torque can be transmitted therebetween. The clutch **177** is disengaged by introducing hydraulic fluid into a cavity **210** formed between the stepped piston **208** (sealed by O-ring **208***a*) and a seal ring **211** (sealed by external O-ring **211***a* and internal O-ring **211***b*). The seal ring **211** is fixed in place longitudinally by a snap ring **213** fitted to the brake housing **129**, and the hydraulic fluid enters the cavity **210** via a port **212** in the brake housing. The hydraulic fluid in cavity **210** forces the stepped piston **208** longitudinally away from the fixed seal ring **211**, overcoming the bias of the springs **134** and allowing the frame **152** of the carrier/clutch unit **150** to move away from the pressure plate **192**. This uncompresses the separators **178** and friction discs **180** of the clutch **177** such that their frictional engagement is significantly reduced. Thus, it will be readily appreciated that the torque transmitted by the carrier/clutch unit **150** (and hence the torque transmitted from the motor shaft **118** to the winch drum **102**), can be varied by controlling the pressure of the hydraulic fluid in the cavity **210**.

The carrier/clutch unit **150** allows the functions of a clutch and a planetary gear carrier to be combined into a very compact unit. If the clutch is engaged, input torque at the sun gear **122** is transmitted as multiplied output torque at the output shaft **144**. If the clutch is not engaged, input torque at the sun gear **122** is not transmitted to the output shaft **144**. This has advantages from the standpoint of cost and space requirements.

When the clutch **177** is fully engaged, torque is transmitted by the carrier/clutch unit **150** from the motor shaft **118** to the secondary sun gear **144** just as with a conventional planetary gear carrier. The secondary sun gear **144**, in turn, has external teeth **214** formed on the end opposite the carrier/clutch unit. These external teeth **214** of the secondary sun gear **144** engage a plurality of circumferentially spaced secondary planet gears **216** mounted on a conventional carrier **218** by means of shafts **219**. The secondary planet gears **216** simultaneously engage a ring gear encircling the carrier. In the illustrated embodiment, the encircling ring gear for the secondary planetary set is provided by internal teeth **220** integrally formed on the inside surface of the winch drum **102**. For purposes of reducing production costs, the internal teeth **220** for the secondary ring gear and the internal teeth **172** for the primary ring gear may be part of the same set of integrally formed gear teeth. In other embodiments, however, the internal teeth of the primary and secondary ring gears may have different tooth pitches and/or may be separately formed rings that are secured in place around their respective planetary set.

As the secondary sun gear **144** rotates, the secondary carrier **218** will rotate in the same direction at a predetermined ratio, thereby multiplying the transmitted torque in the known manner. The secondary carrier **218** maintains fixed constant engagement with the final sun gear **146** by means of splines **222** such that torque can be transmitted therebetween. The final sun gear **146** has external teeth **224** formed on the end opposite the secondary planetary stage. These external teeth **224** may be integrally formed as part of the final sun gear **146**, or alternatively, the final sun gear may be formed from a separate shaft portion and a separate toothed portion which are splined or otherwise joined together. The external teeth **224** of the final sun gear **146** engage a plurality of circumferentially spaced final planet gears **226** mounted on a conventional carrier **228** by means of shafts **230**. The final planet gears **226** simultaneously engage a ring gear **232** encircling the final carrier **228**. It will be appreciated that, as the torque increases with each succeeding planetary stage, the size of the associated sun gear, planet gears and carrier will also increase to handle the necessary loads. Thus, in the illustrated embodiment, the final ring gear **232** is much larger than the secondary ring gear **220**, and is therefore mounted to one side of the winch drum **102**. As the final sun gear **146** rotates, the final carrier **228** will rotate in the same direction at a predetermined ratio as previously described, thus further multiplying the transmitted torque. The final carrier **228** is splined to one end of a drum shaft **234**, and the opposite end of the drum shaft is splined to an internal drum spline **236** on the drum **102**. In this manner, the output torque from the final carrier **228** is transmitted to the winch drum **102**, thus completing the transfer of power from the motor shaft **118** to the winch drum.

It will be readily apparent that the winch **100**, which includes the drum friction clutch after the first stage of gear reduction, substantially reduces the torque-carrying requirements for the clutch in comparison to a winch where the friction clutch is provided after the second or third stage of gear reduction (i.e., where the torques being transmitted are proportionally higher). Thus, the winch **100** can use a friction clutch that is much smaller and/or less expensive to manufacture than other designs. In addition, the use of the carrier/clutch unit **150** incorporating both a planetary carrier and a friction clutch in a single unit further simplifies production of the winch and reduces costs. Further still, use of a common set of springs to activate both the drum clutch and the static brake of the winch also reduces the parts count, further simplifies production, and reduces costs for the winch. Finally, mounting the carrier/clutch unit within the internal cavity of the winch drum makes excellent use of the available space within the winch housing so as to provide for a more compact unit.

Although the preferred embodiment has been described in detail, it should be understood that various changes, substitutions and alterations can be made therein without departing from the spirit and scope of the invention. For example, in another embodiment of the invention, the carrier/clutch unit may be disposed between the secondary sun gear and the final sun gears, rather than between the primary sun gear and the secondary sun gear. In yet another embodiment, the winch may have only two stages of gear reduction, and the entire gear reduction mechanism, including a carrier/clutch unit, maybe disposed within the internal cavity of the winch drum. In still another embodiment, the winch may have only a single stage of gear reduction, but will incorporate a carrier/clutch unit sharing common springs with the static brake assembly. In yet another embodiment, all of the reduction gear sets, including the set incorporating the carrier/clutch unit, may be disposed outside the winch drum. In still another embodiment, some of the winch's reduction gear sets including the carrier/clutch unit may be disposed along a first longitudinal axis, other of the reduction gear sets may be disposed along a second, parallel longitudinal axis, and the gear sets on the two axes are connected by a set of engaged gears, a chain/sprocket arrangement, or other torque transmitting means. In yet other embodiments, the relative movements of the components of planetary gear sets may be rearranged in the known manner. These and other embodiments are defined by the claims as appended hereto.

What is claimed is:

1. A winch comprising:

a drum rotatably mounted on a housing for winding a cable thereupon;

a motor attached to the housing, the motor supplying torque through a motor shaft;

an augmented stage of planetary gears mounted to the housing for transmitting torque between the motor shaft and the drum, the augmented stage of planetary gears including a sun gear for receiving torque, a carrier/clutch unit and an annular ring gear encircling the carrier/clutch unit;

the carrier/clutch unit including

a frame rotatably mounted to the housing and having walls defining a cavity therein;

at least one circumferentially-spaced planet gear rotatably mounted on the frame for simultaneously engaging the sun gear and the ring gear;

a selectively engagable clutch mounted within the cavity of the frame;

an output member which, when the clutch is engaged, can receive useful torque from the frame and, when the clutch is disengaged, cannot receive useful torque from the frame and

a static brake assembly including a over-riding clutch and a multi-disc brake, the static brake assembly being operably connected to the motor shaft.

2. A winch in accordance with claim **1**, further comprising:

at least one conventional stage of planetary gears connected in series with the at least one augmented stage of planetary gears for transmitting torque between the motor shaft and the drum, each conventional stage of planetary gears comprising a sun gear for receiving torque, a carrier having at least one circumferentially-spaced planet gear rotatably mounted thereon, and an annular ring gear encircling the carrier.

3. A winch in accordance with claim **2**, wherein the winch includes one augmented planetary stage and at least two conventional stages of planetary gears connected in series for transmitting torque between the motor shaft and the drum.

4. A winch in accordance with claim **3**, wherein the augmented planetary gear stage receives torque from the motor shaft with no intervening gear stages.

5. A winch in accordance with claim **3**, wherein the augmented planetary gear stage and at least one conventional planetary gear stage share a common annular ring gear.

6. A winch in accordance with claim **5**, wherein the common annular ring gear is integrally formed on the interior surface of the drum.

7. A winch in accordance with claim **3**, wherein the augmented planetary gear stage and at least one conventional planetary gear stage are disposed within the drum.

8. A winch in accordance with claim **1**, wherein the clutch of the carrier/clutch unit is spring applied and the multi-disc brake of the static brake assembly is spring applied.

9. A winch in accordance with claim **1**, wherein at least some of the springs applying the clutch of the carrier/clutch unit are the same springs applying the multi-disc brake of the static brake assembly.

10. In a winch having a housing, a rotating cylindrical winch drum mounted on the housing, a motor mounted to the housing and supplying torque at a motor shaft, and a reduction gear train including a primary planetary gear stage and a secondary planetary gear stage for sequentially transmitting torque from the motor shaft to the winch drum, the improvement comprising:

one of the primary planetary gear stage and the secondary planetary gear stage including a carrier/clutch unit;

the carrier/clutch unit including

a frame rotatably mounted to the housing and having walls defining a cavity therein;

at least one circumferentially-spaced planet gear rotatably mounted on the frame for simultaneously engaging a sun gear and an encircling ring gear;

a selectively engagable clutch mounted within the cavity of the frame;

an output member which, when the clutch is engaged, can receive useful torque from the frame and, when the clutch is disengaged, cannot receive useful torque from the frame; and

a static brake assembly including an over-riding clutch and a multi-disc brake, the static brake assembly being operably connected to the motor shaft.

11. A winch in accordance with claim **10**, wherein the frame of the carrier/clutch unit further comprises:

a radial portion; and

a circumferential portion extending longitudinally away from the radial portion, the circumferential portion defining the interior cavity.

12. A winch in accordance with claim **11**, wherein the clutch of the carrier/clutch unit further comprises:

a plurality of annular separator discs concentrically positioned within the interior cavity around a longitudinally disposed output shaft, the separator discs being rotationally locked with respect to the circumferential portion of the housing and free to rotate with respect to the output shaft;

a plurality of annular friction discs concentrically positioned around the output shaft and interleaved between the separator discs, the friction discs being rotationally locked with respect to the output shaft and free to rotate with respect to the circumferential portion of the housing;

wherein compressing the separator discs longitudinally together frictionally engages the friction discs with the separator discs, allowing the transmission of torque between the sun gear and the output shaft, whereas uncompressing the separator discs frictionally disengages the friction discs from the separator discs such that the output shaft may rotate independently from the sun gear.

13. A winch in accordance with claim **12**, wherein the carrier/clutch unit is disposed within an interior cavity of the cylindrical winch drum.

14. A winch in accordance with claim **12**, wherein the carrier/clutch unit is disposed between a sun gear of the primary planetary stage and a sun gear of the secondary planetary stage.

15. A winch in accordance with claim **12**, wherein the sun gear engaged by the planet gears of the carrier/clutch unit is the primary sun gear.

16. A winch in accordance with claim **12**, wherein the ring gear engaged by the planet gears of the carrier/clutch unit is mounted to an interior surface of the winch drum.

17. A winch comprising:

a support housing;

a winch drum rotatably mounted on said housing, the winch drum having a cylindrical cavity formed therein with an inner surface;

a motor mounted to the support housing and providing torque at a motor shaft projecting therefrom;

a primary sun gear connected to the motor shaft for receiving torque therefrom;

a common internally toothed ring gear formed on the inner surface of the winch drum;

a primary planet carrier positioned within the interior cavity of the winch drum, the primary planet carrier including

a generally cylindrical housing having a radial wall and a circumferential wall extending axially away from the radial wall, the radial wall supporting a plurality of planet gears in radially meshed engagement with the primary sun gear and the common ring gear;

a primary output shaft concentrically positioned at least partially within the interior cavity of the carrier housing;

a clutch including

a plurality of separator discs concentrically positioned around the primary output shaft within the interior cavity, the separator discs being rotationally locked with respect to the circumferential wall and free to rotate with respect to the output shaft;

a plurality of friction discs concentrically positioned around the output shaft and interleaved between the separator discs, the friction discs being rotationally locked with respect to the output shaft and free to rotate with respect to the circumferential wall;

wherein compressing the separator discs axially together frictionally engages the friction discs with the separator discs, allowing the transmission of torque between the carrier housing and the primary output shaft, whereas releasing the compression allows the separators to frictionally disengage the friction discs such that the carrier housing may rotate independently from the primary output shaft;

a secondary sun gear positioned within the interior cavity and fixed to the primary output shaft;

a secondary planet carrier positioned within the interior cavity of the winch drum, the secondary planet carrier supporting a plurality of planet gears in radially meshed engagement with the secondary sun gear and the common ring gear; and

a secondary output shaft rotatably mounted in the housing and connected to the secondary planet carrier to rotate with the secondary planet carrier; and

a static brake assembly including a over-riding clutch and a multi-disc brake, the static brake assembly being operably connected to the motor shaft.

18. A winch in accordance with claim **17**, wherein clutch of the primary planet carrier is spring applied and the multi-disc brake of the static assembly is spring applied.

19. A winch in accordance with claim **18**, wherein at least some of the springs applying the clutch of the primary planet carrier are the same springs applying the multi-disc brake of the static brake assembly.

20. A winch in accordance with claim **5**, wherein the winch drum has internal teeth integrally formed on the inside surface of the drum itself constituting the common annular ring gear.

21. A winch in accordance with claim **17**, wherein the winch drum has internal teeth integrally formed on the inside surface of the drum itself constituting the common annular ring gear.

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